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The validation of a scale to measure cognitive development in Chinese preschool children

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ABSTRACT

The present study aimed to evaluate the reliability and validity of the cognitive sub-test of the Preschool Developmental Assessment Scale (PDAS) for Hong Kong Chinese children. Participants included 378 children (189 boys and 189 girls) aged 3–6 years old, with 324 children with typical development and 54 children with developmental disabilities. They were administered the cognitive sub-test of the PDAS and the Wechsler Preschool and Primary Scale of Intelligence – Revised (WPPSI-R). The PDAS cognitive sub-test total scores correlated positively with the WPPSI-R scores. It could differentiate children from different age groups, with younger children attaining significantly lower scores than older children. The sub-test could also differentiate children with typical development from those with developmental disabilities, with the latter attaining significantly lower scores. The sensitivity and specificity were around 80%. Internal consistency (KR-20) was .93 and test–retest reliability was .81. The cognitive sub-test of the PDAS was found to be a promising screening tool for the identification of preschool children with developmental disabilities.

1. Introduction

Early identification and early intervention are important to enable children with developmental disabilities to develop their potential to the fullest (Hamilton, 2006). To make early identification possible, reliable and valid instruments are needed so that children with developmental disabilities can be identified (Elbaum, Gattamorta & Penfield, 2010).

1.1. Existing assessment tools for preschool children

There are many available tests for the diagnostic assessment of preschool children such as the Griffiths Mental Development Scale, (Huntley, 1996), the Bayley Scales of Infant and Toddler Development – Third Edition (Bayley, 2006), the Stanford–Binet Intelligence Scale (Roid, 2003), and the Wechsler Preschool and Primary Scale of Intelligence (Wechsler, 2002). However, these tests can only be administered by qualified professionals such as psychologists or paediatricians and they are lengthy in administration time. It may not be most cost-effective to use these diagnostic tests for the screening of children with suspected developmental disabilities because of its high demand on professional time, and its impact on the waiting time of children on the waiting list for assessment services. A short screening test which can identify children who need further assessment is a more viable strategy. Children identified through the short screening test can then be offered further assessment using diagnostic tools.

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There are various developmental screening tests available, such as the Batelle Developmental Inventory, second edition, screening test (BDI-2-ST, Newborg, 2005), or the Bracken Basic Concepts Scale (Bracken, 1998; Laughlin, 1995). However, these tests might not be entirely appropriate for non-English speaking communities, such as the Hong Kong Chinese community. He and Wolfe (2010) examined the item equivalence of a 51-item test partly based on the BDI and Bracken Basic Concept Scale. This 51-item test was translated into Chinese and reviewed for cultural and language comparability. They found that 59% of the items exhibited moderate or substantial levels of differential item functioning (DIF), suggesting that the probability of passing these items was different for children from different cultural groups. The difference in probability of passing could probably be due to item content which was differentially familiar to children from different cultural groups. Another commonly used screening test is the Denver II (Frankenburg, Dodds, Archer, Shapiro, & Bresnick, 1992) but it has been criticized for its low specificity (Hamilton, 2006). Furthermore, there are no local norms for these tests for Hong Kong Chinese children.

1.2. Calculation

1.2.1. The Preschool Developmental Assessment Scale (PDAS)

The Preschool Developmental Assessment Scale (PDAS) was developed as a comprehensive assessment tool for preschool children in Hong Kong. In line with the Early Learning Benchmarks (Kagan, Britto, Kauerz, & Tarrant, 2005) which acknowledged the multidimensional nature of early learning and development as well as the inter-connection of developmental domains, the PDAS incorporated cognitive, social, language, motor, literacy, numeracy and visual-perceptual domains. It consisted of eight sub-tests covering cognitive (40 items), social (29 items), language (68 items), literacy (42 items), numeracy (5 items), visual perception (41 items), fine (11 items) and gross motor skills (15 items). Item development took into consideration the local context and the stimulus pictures included items familiar to local Hong Kong children such as Chinese eating utensils, local currency, local stores and local preschool uniforms. Children identified to have significant delays in particular sub-tests could then be referred to professionals in the specific areas for further assessment (Leung, Mak, Lau, Cheung, & Lam, 2010).

This paper described the second stage validation of the cognitive sub-test of the PDAS. As each sub-test was validated against criterion measures in their respective areas, full description of their rationale and validation were reported separately (e.g. Leung, Cheung, Lau, & Lam, 2011; Wong, Leung, Siu, & Lam, 2012).

Within the context of the multidimensional nature of early learning and development, the major focus of the cognitive sub-test was on children's acquisition of basic concepts. This was based on the premise that acquisition of basic concepts was fundamental to the intellectual functioning of children (Panter, 2000). Basic concepts were regarded as the foundation of knowledge in early childhood and they played a significant role in literacy development. Basic concepts also correlated with intelligence, school readiness and academic achievement (Bracken & Crawford, 2010).

The pilot version of the PDAS cognitive sub-test consisted of 87 items. Based on Rasch analysis results, 47 items were removed, resulting in a 40-item version (Leung et al., 2010). It could differentiate children with developmental disabilities from children with typical development, as well as children in different age groups. The results of this pilot study suggested that the cognitive sub-test of the PDAS was a promising instrument for screening children who might need further assessment. However, psychometric properties such as convergent and criterion validity, test–retest reliability, sensitivity and specificity have not been established.

1.2.2. The validation study

We aimed to validate the 40-item version cognitive sub-test developed in the pilot phase (Leung et al., 2010) and present evidence for the subtest's test–retest reliability, convergent and criterion validity, as well as sensitivity and specificity. The present study differed from the Leung et al. (2010) pilot study in four ways. First, a completely new sample was recruited, though the same inclusion and exclusion criteria as that in the pilot stage were used. Second, the correlation between the PDAS cognitive sub-test with a validated tool, the Wechsler Preschool and Primary Scale of Intelligence – Revised (WPPSI-R), would be investigated. Third, test–retest reliability would be assessed. Fourth, cut-off scores for referral for further assessment would be established and their sensitivity and specificity would be examined.

Holmbeck and Devine (2009) provided a checklist on evidence-based assessment. According to them, this checklist "represented what would ideally be expected" (p. 692), but it was recognized that no single study could fulfil all the requirements listed in the checklist. In the following, the present study on the validation of the PDAS cognitive sub-test was discussed with reference to the checklist by Holmbeck and Devine (2009).

In terms of reliability, it was recommended that both internal consistency and temporal stability should be examined (Holmbeck & Devine, 2009). In the present study, KR-20 would be used as a measure of internal consistency and intraclass correlation would be used as a measure of test–retest reliability.

For quantitative item analysis, Rasch analysis was recommended to be used to examine the unidimensionality of the items, which was the basic requirement for summing up item scores to form a total score. Differential item functioning (DIF) should also be examined for item bias (Holmbeck & Devine, 2009). In this study, the infit and outfit mean square statistics would be examined to investigate whether the unidimensionality requirement could be met (Bond & Fox, 2007). Items with infit and outfit statistics between 0.7 and 1.3 (unstandardized mean squares) were considered acceptable (Bond & Fox, 2007).